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Means for improving the utilisation in a turbine of exhaust gases from an internal comb engine

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Publication date:	1932-05-12
Inventor:	
Applicant:	RATEAU SOC
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Application number:	GB19310013546 19310507
Priority number(s):	DEX372556 19301210

Abstract not available for GB372556

FIG.1.

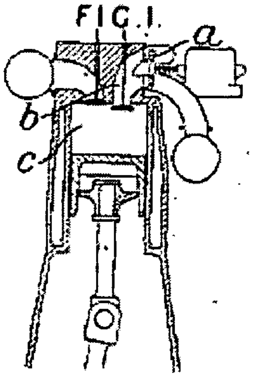
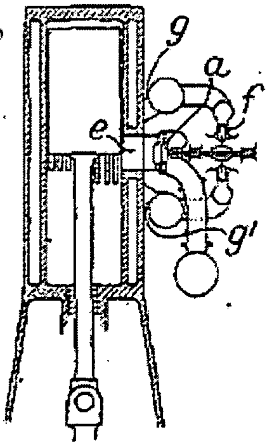


FIG.3.



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PATENT SPECIFICATION

Convention Date (Germany): Dec. 10, 1930.

372,556

Application Date (in United Kingdom): May 7, 1931. No. 13,546 / 31.

Complete Accepted: May 12, 1932.

COMPLETE SPECIFICATION.

Means for Improving the Utilisation in a Turbine of Exhaust Gases from an Internal Combustion Engine.

ERRATUM.

SPECIFICATION No. 372,556.

In the heading on page 1, *for* "(Germany): Dec. 10, 1930" *read* "(France): May 10, 1930"

THE PATENT OFFICE,

2nd August, 1932.

D G 1112-4 · 125 H B

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and the loss of power resulting therefrom. In a multiple-cylinder engine it has been the practice to connect two or more cylinders with one turbine which, in addition to increasing the volume of the passageways, is the cause of disturbance of the exhaust of one cylinder by that of another cylinder connected with the same turbine.

According to the present invention, in a multiple cylinder engine, each cylinder is provided with an independent exhaust gas turbine which is connected directly with the exhaust port of the corresponding cylinder with the interposition of a passageway of a minimum volume in which no substantial expansion takes place, the turbine being supplied at a pressure varying during the exhaust period.

If the pressure in the cylinder of an internal combustion engine and in the pipes be measured, it will be found that,

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of gas which should enter the nozzles.

The capacities of the intermediate piping, therefore, play the part of a silencer, in which a large portion of the potential energy contained in the exhaust gases is dissipated beyond recovery, and, as the result of this fact, a loss is sustained of a large portion of the benefit of compounding the engine with a gas turbine, the theoretical advantage of which would consist in utilising that portion of the cylinder diagram which the restricted stroke of the reciprocating engine does not allow it to utilise (loss by truncated expansion).

In the arrangement according to the present invention, as the pressure falls in the exhaust passage at the end of the exhaust period, the scavenging of the engine is less inconvenienced than in the known arrangements where the engine exhausts into a conduit wherein the pressure does not vary during the exhaust

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Means for Improving the Utilisation in a Turbine of Exhaust Gases from an Internal Combustion Engine.

We, Société Rateau, of 40, Rue du Colisée, Paris, France, a body corporate, organized under the laws of France, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to internal combustion engines connected in compound relation with a turbine, the exhaust gases of the engine being further expanded in the turbine to furnish power at the turbine shaft in addition to the power obtained at the engine shaft.

In the usual arrangements of engines exhausting into turbines, the connection is effected by means of pipes of relatively large volume, and the existence of such volume is the cause of the inconveniences which the present invention is intended to obviate. Although in many known arrangements the intermediate passageways may be of short length, the special reduction of volume has not been provided so that in said known arrangements the turbine was not supplied at a pressure varying from the beginning to the end of the cylinder exhaust period with a view to avoiding an expansion in said passageway and the loss of power resulting therefrom. In a multiple-cylinder engine it has been the practice to connect two or more cylinders with one turbine which, in addition to increasing the volume of the passageways, in the cause of disturbance of the exhaust of one cylinder by that of another cylinder connected with the same turbine.

According to the present invention, in a multiple cylinder engine, each cylinder is provided with an independent exhaust gas turbine which is connected directly with the exhaust port of the corresponding cylinder with the interposition of a passageway of a minimum volume in which no substantial expansion takes place, the turbine being supplied at a pressure varying during the exhaust period.

If the pressure in the cylinder of an internal combustion engine and in the pipes be measured, it will be found that, at the beginning of the exhaust stage, the pressure in the cylinder is, for example, of the order of 42 lbs. per sq. in. (this pressure varying according to the type of the engine and the arrangement of the distribution), and that said pressure then drops more or less rapidly, the form of the pressure-variation curve, varying according to the setting of the valve, the cross-sectional area of the group of the gas-turbine nozzles, and the capacity of the intermediate pipes. On the other hand, it is found that the pressures at the turbine intake never attain similar values, the pressures at the beginning of the exhaust stroke, in particular, being very much lower than the pressures in the cylinder.

If, for a given engine and group of nozzles, calculation be made of the values which should be attained by the pressure in the pipes in question, it is found that these values differ very considerably, according to the capacity of said pipes, and that they are lower in proportion as the piping is larger. At the limit, in the case of piping of very large capacity, the pressure, would remain constant, and be equal to that corresponding with the permanent delivery of the flow of gas which should enter the nozzles.

The capacities of the intermediate piping, therefore, play the part of a silencer, in which a large portion of the potential energy contained in the exhaust gases is dissipated beyond recovery, and, as the result of this fact, a loss is sustained of a large portion of the benefit of compounding the engine with a gas turbine, the theoretical advantage of which would consist in utilising that portion of the cylinder diagram which the restricted stroke of the reciprocating engine does not allow it to utilise (loss by truncated expansion).

In the arrangement according to the present invention, as the pressure falls in the exhaust passage at the end of the exhaust period, the scavenging of the engine is less inconvenienced than in the known arrangements where the engine exhausts into a conduit wherein the pressure does not vary during the exhaust

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period but remains at a substantially constant mean value which is higher than the pressure at the end of the exhaust obtained by the present invention.

In the accompanying drawing, which illustrates diagrammatically and by way of example, some embodiments of the invention, Figure 1 is an axial section through a 4-stroke Diesel engine cylinder, exhausting into a turbine, and Figure 2 is a corresponding plan. Figure 3 is an axial section through the cylinder of a double-acting 2-stroke engine connected with a turbine.

In the application to a 4-stroke Diesel engine as shown in Figures 1 and 2, the turbine *a* is mounted directly on the exhaust *b* of the cylinder *c*. This arrangement furnishes an increased amount of available energy at the turbine shaft. The resulting extra power will be utilised in any way whatsoever, the turbine driving a power-consuming device indicated by *d*.

If the turbine drives a blower, or air compressor, which feeds the engine, the increased power may be utilised for increasing the difference between the mean pressure of the exhaust gases and the delivery pressure of the blower.

The delivery side of the blower may be connected with the intake of one of the engine cylinders, this being selected in order to obtain the best possible correspondence between the driving torques and the resisting torques. Alternatively, the blower may deliver into a common receiver supplying all the cylinders.

One advantage resulting from this invention lies in the fact that if the exhaust pipe of the turbine be cooled by, for example, a water circulation, there will be no longer any hot pipes capable of raising the temperature of the engine room.

With the known arrangements, on the other hand, the necessity for admitting the gases into the turbine at the highest temperature possible, made it necessary to avoid, as far as practicable, any cooling of the pipes supplying the gases to the turbine, and consequently a source of heat always remained present in the engine rooms.

One turbine is employed for each cylinder, as shown in Figures 1 and 2 (for high-powered engines).

Another application consists in supercharging 2-stroke engines, for which purpose it has hitherto been impossible to employ exhaust-gas turbo-blowers, operating without any auxiliary source of energy, owing to the low temperature of the gases and the necessity for having a very considerable difference between the admission and exhaust pressures of the engine so as to enable the combustion chamber to be scavenged during the very short time occupied by the admission and exhaust of the engine.

As a result of the greater power available at the turbine shaft, the blower driven by the latter will suffice to assure the feeding and scavenging, and it will be possible to reduce considerably the power of the auxiliary scavenging blower disposed in series with the blower of the gas-driven turbo-blower, and driven by a different engine. In some cases it may even be possible to dispense with said scavenging blower completely.

The special arrangement shown in Figure 3 of the members of the double-acting 2-stroke engine enables the invention to be applied in a particularly simple and advantageous manner. In this case, the exhaust turbine *a* utilises the two actions of one and the same cylinder *c*, and is then disposed midway of the cylinder, on the common exhaust port *e*, as shown in Figure 3, which represents the turbine driving a blower *f* supplying the intakes *g* g^1

The invention may be applied also to gas engines in which the loss by truncated expansion is very considerable, owing to the high value of the pressure at the beginning of the exhaust stage, the temperature of the gases enabling a considerable amount of power to be recovered by expansion in a turbine.

In the case of a gas engine, it is possible to consider, for example, the utilisation of an alternator driven by the gas turbine and operating in parallel with the electric main fed by external means. In this particular instance the velocity of the group formed by the alternator and gas turbine would remain constant.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Means for improving the utilisation of the exhaust gases from an internal combustion engine in a turbine, wherein in a multiple-cylinder engine, each cylinder is provided with an independent exhaust gas turbine which is connected directly with the exhaust port of the corresponding cylinder with the interposition of a passageway of a minimum volume in which no substantial expansion takes place, the turbine being supplied at a pressure varying during the exhaust period.

2. A two-stroke engine connected with a turbine according to claim 1, and supercharged by a blower driven by the tur-

bine, said blower effecting also scavenging of the engine without additional power or in conjunction with an auxiliary series blower of a reduced power, owing to the increased power available at the turbine shaft.

3. An internal combustion engine in compound relation with an exhaust gas turbine, constructed and arranged substantially as hereinbefore set forth with reference to the accompanying drawings.

Dated the 7th day of May, 1931.

A. M. & WM. CLARK,
Chartered Patent Agents,
53 & 54, Chancery Lane, London, W.C. 2.

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372,556 COMPLETE SPECIFICATION 1 SHEET

[This Drawing is a reproduction of the Original on a reduced scale]

Fig. 3.

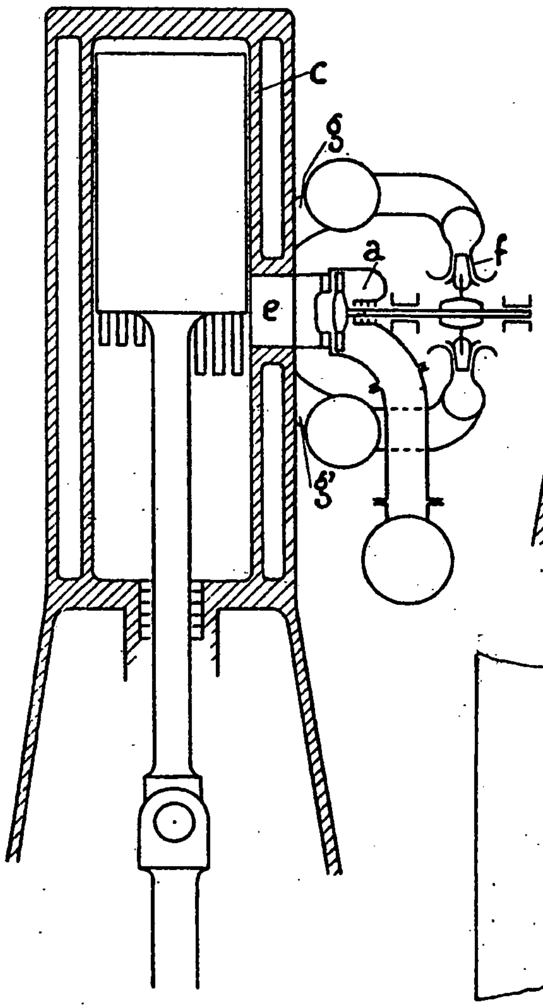


Fig. 1.

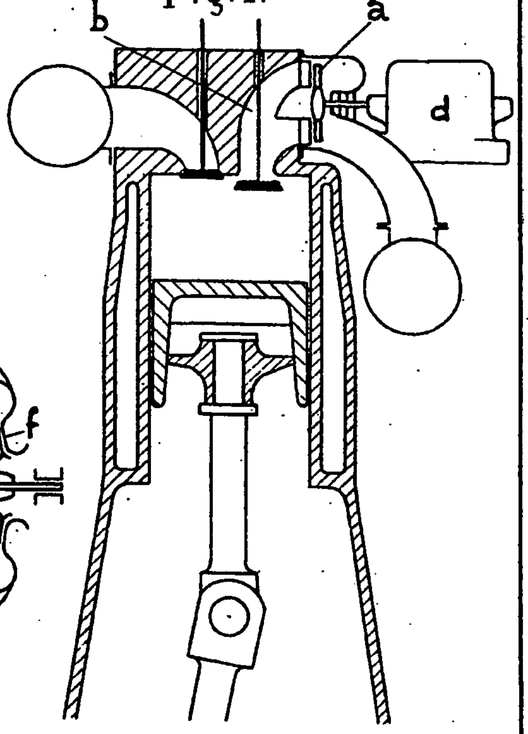
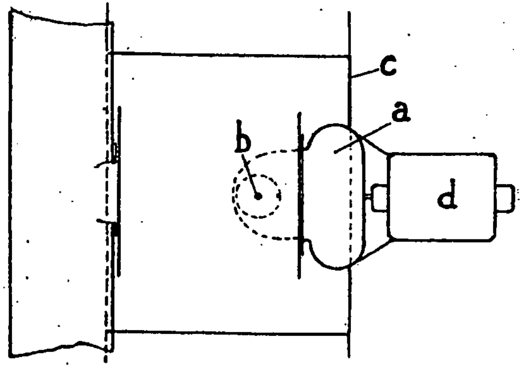


Fig. 2.



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